Willingness-to-pay for precautionary control of microplastics; a comparison of hybrid choice models.

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Abstract

The environmental and health effects of microplastics in the aquatic environment are uncertain. Given inherent uncertainties in the link between microplastics and health, precautionary policies to restricts microplastics release may be followed. This paper estimates Willingness-to-Pay (WTP) for three policy options intended to limit the potential adverse consequences of microplastic pollution. WTP is estimated using two Contingent Valuation (CV) questions. The effect of precautionary concern on WTP is identified by exploiting a novel Integrated Choice and Latent Variable (ICLV) specification. This paper's crucial innovation is an estimation of the precautionary premia – the marginal increase in WTP for precautionary measures. When latent variables are considered, the estimated precautionary premia are amplified. The results suggest that subjective perceptions of microplastics' uncertain effects could be a strong determinant on preferences for precautionary policies.

Keywords: Uncertainty, hybrid choice models, stated preference *JEL classification:* Q5, Q51, Q58

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1. Introduction

This paper examines the effect of a latent precautionary attitude on WTP for restrictions on microplastics. Microplastics are polymer-containing particles smaller than 5mm, which may be intentionally added to consumer products (ECHA, 2019). Lebreton, Egger and Slat (2019) estimated that microplastics are increasingly released to the marine environment. This rising concentration may proxy for greater risk as it increases the risk of human and marine life ingesting microplastics (Lusher, Hollman and Mendoza-Hill, 2017; Lebreton, Egger and Slat, 2019; Thompson et al., 2009). However, the scientific evidence on the toxicity, concentration and effects of microplastic ingestion is uncertain, indicating that any benefits of restrictions would be precautionary. The precautionary principle suggests that scientific uncertainty should not delay measures to abate damages (Courbage, Rey and Treich, 2013). Although policymakers commonly use the precautionary principle, this research is somewhat unique in evaluating the benefits of a precautionary approach at the respondent level instead. Using WTP estimates, this paper finds that the benefits of a precautionary act-then-learn approach are higher than a learn-then-act strategy, which would delay a decision.

There is uncertainty about the future environmental and health impacts of microplastic ingestion. Although there is no current evidence suggesting that levels of human ingestion of marine microplastics have deleterious consequences (Lusher, Hollman and Mendoza-Hill, 2017), a range of physical and chemical health effects have been hypothesised or observed in some marine life. For instance, microplastics could leach contaminants or translocate across bodily tissues when ingested (Duis and Coors, 2016; Koelmans et al., 2016). There is also the possibility for the trophic transfer of microplastics through marine life to eventually affect human health via the ingestion of seafood or water (Kosuth, Mason and Wattenberg, 2018; Lusher, Hollman and Mendoza-Hill, 2017; Bergmann, Gutow and Klages, 2015; ECHA, 2014). However, there are two challenges to this. Firstly, Koelmans et al. (2016) disputes the leachate possibility as they found that ingestion of microplastics did not significantly increase contaminants' ingestion. Indeed, while Thompson et al. (2009) acknowledged that humans might ingest microplastics, they note that it is at an extremely low level unlikely to lead to any adverse effects. Secondly, Burns and Boxall (2018) urged caution when describing the potential effects of microplastics as many studies had relied on potentially

unrealistic laboratory conditions. However, with the increasing release and concentration of microplastics, microplastics' ingestion may increase above a no-effect threshold, although the exact limit has not yet been identified (Lebreton et al., 2018). Given the potential for future adverse effects, the European Chemicals Agency proposed a restriction on microplastics. This restriction is underpinned by the precautionary principle, suggesting that the current absence of scientific certainty on the potential effects should not be a barrier to restrictions. However, to date, there has been relatively scarce study of the support for precautionary policies at the individual level.

While the costs of restricting microplastics are known, the benefits are not (ECHA, 2019). Estimating the benefits allows a more complete consideration of the value to precautionary restrictions. The benefits can be estimated ex-ante in WTP terms; however, there is a rich debate on appropriate elicitation methods for WTP. A common recommendation from the stated preference literature is to gather data on respondents' attitudes towards the scenario as WTP is positively influenced by attitudes towards and concern for environmental issues (Arrow et al., 1993; Johnston et al., 2017; Faccioli et al., 2020). For example, stronger attitudes towards pollution abatement often correspond to an increased likelihood to vote for hypothetical measures and thus higher WTP (Spash, 2006; Kotchen and Reiling, 2000). Moreover, the literature has commonly reported that WTP is more strongly influenced by attitudes towards specific, rather than general, issues (Kollmuss and Agyeman, 2002; Fransson and Garling, 1999; Spash, 2006; Cooper, Poe and Bateman, 2004; Dunlap and D. Van Liere, 2008). Therefore, respondents in this research are specifically asked how concerned they are with the potential human health effects of microplastics rather than just their general concern about water pollution.

This research is novel in examining the effect of precautionary attitudes on WTP for microplastic restrictions. The Integrated Choice Latent-Variables (ICLV) results from two CV questions is used to determine how concern about the possible effects of microplastics influences WTP for precautionary restrictions. This paper is structured as follows. Firstly, the theoretical mechanism to link attitudes to WTP is explored. Secondly, the motivation and practice of the novel ICLV method are discussed. Finally, we discuss the implications for the environmental economics literature.

2. Literature Review

Environmental attitudes have been commonly shown to influence WTP significantly (Kotchen and Reiling, 2000; Spash, 2006). However, estimating the effect of attitudes on WTP is an empirical challenge, Hess and Beharry-Borg (2012); Vij and Walker (2016). Specifically, as attitudes are latent, they cannot be directly observed. Commonly-used indicators, such as Likert scales, are, therefore, are a function of attitudes (Buckell, Hensher and Hess, 2021). Within this function is the possibility of measurement error if respondents interpret the item and levels differently. Moreover, attitudes and utility may be jointly determined by an unobserved factor, in which case Vij and Walker (2016) argued that linearly including attitudinal indicators may raise the possibility of endogeneity. Instead, Likert scales can be treated as indicators of a latent, unobserved, attitude which facilitates the latent variable approach. Latent variables can be integrated with choice models using the ICLV model [1]. The ICLV has been used previously to model latent concepts including addiction (Buckell, Hensher and Hess, 2021), professionalism (Sandorf, Persson and Broberg, 2020), certainty (Dekker et al., 2016), consequentiality beliefs (Czajkowski et al., 2017), environmental attitudes (Faccioli et al., 2020) and concerns about plastics (Abate et al., 2020). Similarly to Abate et al. (2020), the latent attitude in this research is one of concern about the potential health effects of microplastics. However, this research extends Abate et al. (2020) by using the ICLV to understand CV data. The motivation for analysing this data using the ICLV rather than more common probit models is that the ICLV can indicate how latent precautionary attitudes influence WTP. The survey design used in this paper includes three attitudinal indicators that measure respondents' concern about microplastics' potential adverse effects. In this paper, three indicators are used to suggest a latent precautionary attitude that drives WTP.

There are two studies closely related to this one; Abate et al. (2020) and Faccioli et al. (2020). Each study implements a hybrid choice model with latent environmental attitudes that influence the willingness to pay for changes in the environment. However, the studies differ in the number and type of latent attitudes, indicators, and scenarios. The most similar research is Abate et al. (2020), which modelled the effect of two latent environmental

[1] Czajkowski et al. (2017) noted that the ICLV has also been called the 'Hybrid Choice' class of models.

attitudes on WTP for reductions in marine plastics. Although their research also elicited WTP from CV questions, they evaluated a proposal in Norway to reduce marine plastics in Arctic ice. In contrast, we evaluate the European Chemicals Agency proposal to restrict microplastics' release to both the terrestrial and marine environments. Moreover, this research follows their method of comparing probit results to the ICLV, although WTP can be recovered in our model. Abate et al. (2020) approach was twofold. Firstly, sample median WTP (of $642 per household per year) was elicited using a bid-only univariate probit model. Secondly, an ICLV was estimated with two latent attitudes, perceived effectiveness and concern for microplastic, to understand how attitudes influence WTP. The two latent attitudes have one and five indicators, respectively. By comparison, this research has one latent attitude, precautionary concern, and three indicators. However, both ICLV specifications include socioeconomic variables in the structural equation; gender, age, education, income, and charity involvement. Overall, this paper extends Abate et al. (2020) in using the ICLV to evaluate how latent attitudes influence precautionary choices in CV questions.

Similarly to Abate et al. (2020), Faccioli et al. (2020) evaluated the effect of environmental attitudes on WTP using a hybrid choice approach. Faccioli et al. (2020) they use two latent variables, general environmental attitudes and place identity, in their hybrid choice model. However, a notable difference from this research is the mechanism to support WTP; in Faccioli et al. (2020) respondents may support peatland restoration given improved provision of ecosystem services, while in this research, respondents may be WTP to avoid potential adverse health effects in the future. Another difference is that Abate et al. (2020) uses the ICLV with univariate probit as the choice model, whereas Faccioli et al. (2020) use the hybrid mixed logit model, as does this research for the CE component. Their data, further described in Glenk and Martin-Ortega (2018), is a CE with 585 nationally representative respondents, which reports significantly higher WTP than this research. Their data elicit environmental concern using 15 items from the New Environmental Paradigm scale (Dunlap and D. Van Liere, 2008). This scale gathers general environmental concern although Spash (2006) believed that eliciting specific concerns was more appropriate. Although the number of items may add to survey length and complexity, their scale was a validated scale with high construct validity. Faccioli et al. (2020) include their four-level Likert scale responses to the scale in the hybrid model's measurement

equation to indicate their latent variable of general environmental attitudes. In general, the robust conclusion from their research is that hybrid choice models, such as the ICLV, can show how environmental attitudes influence WTP.

This research is concerned with the effect of a specific attitude, precaution, on WTP. Precaution, broadly defined as a prudent activity in the face of uncertainty, is distinct to prevention, reducing the probability of a loss, and so deals with risks rather than uncertainty (Gollier and Treich, 2003; Courbage, Rey and Treich, 2013). The presence of uncertainty may delay a decision while uncertainty is resolved (Traeger, 2014). However, in the presence of the irreversible loss of pollutants, such as the unrecoverable release of microplastics, uncertainty can mediate an immediate restriction (Arrow and Fisher, 1974; Henry, 1974; Traeger, 2014). The suggestion that uncertainty should not preclude restrictions is enshrined in the precautionary principle (ECHA, 2019; Gollier and Treich, 2003). Kuntz-Duriseti (2004) discusses possible economic interpretations of the precautionary principle and demonstrates that uncertainty reduces welfare, thus implying support for precautionary abatement. The negative effect of uncertainty on welfare is also reported in Cameron (2005) in the context of option value for climate change mitigation. Faccioli, Kuhfuss and Czajkowski (2019) observed that uncertainty positively influenced the magnitude of WTP. Furthermore, Svensson (2009) reported no correlation between self-reported precautionary behaviours and stated WTP. It is important to understand the effect of precaution on WTP as it indicates the degree of individual support for policymakers following the precautionary principle in the presence of uncertainty and irreversibility.

3. Survey Methods

This survey used a survey to elicit WTP for two policy options. The survey included a choice experiment, two CV questions, and three attitudinal indicators. Discussion of the choice experiment, which aimed to describe the tradeoffs implicit in reformulating cosmetic products to substitute out microplastics, is omitted from this research in favour of greater exploration of the CV modelling.

Two CV questions were included to elicit sample WTP for two different public-good policy options to understand how respondents value precaution.

The first question elicits WTP for research into microplastics that would resolve uncertainty. The second question elicits WTP for investment into Wastewater Treatment Plants (WWTP) that would reduce the irreversible release of microplastics to the environment. This research uses the Single-Bound Dichotomous Choice format for both questions [2]. This research argues that the difference between the WTP for each question can be interpreted as the increase in benefits from implementing precautionary control measures immediately, rather than delaying to resolve uncertainty; therefore, a premium on individual WTP for precautionary restrictions. This premia is important to identify as it suggests individual-level support for precautionary policies. This research investigates how attitudes motivate precaution and how that influences WTP.

The first CVM question represents the value of hypothetically resolving the scientific uncertainty about microplastics' environmental and health impacts. The pre-tested question text is below;

Q6 *"One possible policy option would be to fund research into the long-term environmental and health effects of microplastics in the environment. The research would definitely resolve the scientific uncertainty about any possible effects, though it would have no effect on the amount of microplastics currently entering the environment from wastewater sewerage.*
An increase in your water bills would cover only the cost of this research. Any follow up action, depending on the research findings, would be funded separately. Would your household be willing to pay £X per year in extra water bills specifically for such research?"

The bid vector was randomly varied with eight levels: 5, 10, 20, 40, 60, 80, 90, 100. Eight levels were used to provide greater information on WTP distribution while maintaining a relatively high number of responses at each bid level. 364/670 respondents answered this question first, while 304/670 answered it second. All respondents answered all the CV questions before the choice experiment and the attitudinal questions. The payment vehicle was extra annual water bills at the household level. Water bills were

[2] A follow-up question is asked for Q7, but we omit that discussion here to focus on attitudes towards WTP.

chosen instead of income tax given evident tax-aversion in the pre-testing. The status quo is that research may occur, but it is uncertain when and if it resolves the scientific uncertainty.

The second CV question elicited WTP for a public-good measure to restrict the release of microplastics, although no uncertainty would be resolved. This question used the same bid levels: 5, 10, 20, 40, 60, 80, 90, 100.

Q7[3] *"Suppose that the UK was going to introduce a policy that would stop microplastics from wastewater sewerage entering the environment now, before waiting for the results of the research discussed in the previous question.*
This policy would pay to upgrade wastewater treatment plants filtering systems so that they would capture all the microplastics in sewerage wastewater heading to the environment.
An increase in your water bills would be used to pay for the cost of this investment. Would your household be willing to pay £X per year in extra water bills to implement this policy?"

The order of the two CV questions was randomised to control for ordering effects (Day et al., 2012). The wording of the two scenarios was changed depending on order to stress that the policies are substitutes and not complements; respondents were also informed that the two policies would not run consecutively. Therefore, the respondents were shown to value the two scenarios independently.

A notable addition to the survey was three attitudinal questions used to indicate a latent precautionary attitude towards microplastics. This attitude may be interpreted as the respondent's subjective concern about the perceived threat of microplastics to human health; therefore, it informs the precautionary motivation underpinning WTP. The three questions are

[3]The wording here is taken from the Q6 then Q7 ordering, and so mentions previous valuation scenarios. The text is suitably amended in the reversed order. Furthermore, the text is amended in the second question to justify asking a second valuation question. Finally, note that both scenarios are UK-specific and cannot easily be aggregated to the larger and more diverse European Chemicals Agency proposed measure.

Likert scales (range 1-5). A Cronbach's Alpha of 0.81 (0.80-0.82) is reported for the three indicators, suggesting that they all indicate the same attitude. Table 1 reports the percentage of the full sample choosing levels on the Likert scale ranging from "1:Completely Disagree" to "5:Completely Agree". The mean score is also reported, with respondents reporting that they are most concerned about the current threat to the environment, then the future threat to themselves with the least concern for their current exposure to microplastics. One challenge to the validity of the scales is that they are liable to central tendency or social desirability biases. However, there is little evidence of these in the results given online surveying and the range of responses to each question. Furthermore, WTP can be interpreted as an intention, and the link between attitudes and intention is relatively stronger than that of attitudes on behaviour (Faccioli et al., 2020; Abate et al., 2020; Kollmuss and Agyeman, 2002)

Table 1: **Summary of attitudinal indicators.**

Question	**1**	**2**	**3**	**4**	**5**	**Mean**
Q13) Please indicate the degree to which you think that microplastic pollution currently presents a threat to yourself.	4.78%	8.21%	43.28%	27.46%	16.27%	3.42
Q14) Please indicate the degree to which you think that microplastic pollution will in the future present a threat to yourself.	2.99%	5.52%	30.45%	36.27%	24.78%	3.74
Q15) Please indicate the degree to which you think microplastic pollution currently presents a threat to the environment.	1.79%	4.48%	22.99%	32.24%	38.51%	4.01

The survey was designed in accordance with the best-practice guidance in Arrow et al. (1993) and Johnston et al. (2017) and used a pre-testing process. The survey instrument consisted of five sections; socioeconomic questions, CV questions, the choice experiment (discussion in forthcoming research), environmental indicators, and finally, debriefing questions. Six hundred seventy respondents completed the survey in April 2020 with an estimated response rate of 65% which compares favourably with the literature (Abate et al., 2020; Jørgensen et al., 2013; Logar et al., 2014; Adamowicz et al., 2011). The median completion length was 7.5 minutes. Table 2 indicates that the sample was broadly representative of the UK adult population. Finally,

it should be noted that respondents failing a dominated test, believing the survey to be inconsequential, or reporting a low understanding of the survey were excluded from the truncated sample (Foster and Mourato, 2002; Vossler and Watson, 2013; Rakotonarivo, Schaafsma and Hockley, 2016; Schaafsma et al., 2014). Respondents were asked to indicate their certainty about their valuations, and those reporting the lowest-level of uncertainty were also excluded from the truncated sample as this may indicate hypothetical bias in the responses (Scasny and Zvěřinová, 2014). Protest voters were identified from the text responses as those stating that they are against paying anything for the scenario and excluded from the truncated sample. Given the five possible rules, the truncated sample size was 304; while this is a high truncation rate, it indicates that the remaining responses are highly valid.

Table 2: **Full sample characteristics:**

Category	**Sample**	**Population**
Gender	Male: 46% Female: 53%	Male: 49% Female: 51%
Age	Mean: 42 years old	Mean: 38 years old
Education	A level or equivalent: 50.75% Graduate or more: 49.25%	A level or equivalent: 40.4% Graduate or more: 42%
Employment	Prefer not to say = 2.68% NEET = 11.34% Retired = 7.76% Student = 4.47% Part-time = 14.95% Self-employed = 6.85% Full-time = 51%	NEET: 3.7% Student: 3.5% Part-time: 10.4% [1] Self-employed: 15.1% Full-time: 36.9%
Gross monthly income	Mean: £2193[2]	Mean: £2340[3]
Order	Order 1: 364 Order 2: 306	The split-samples are slightly unbalanced

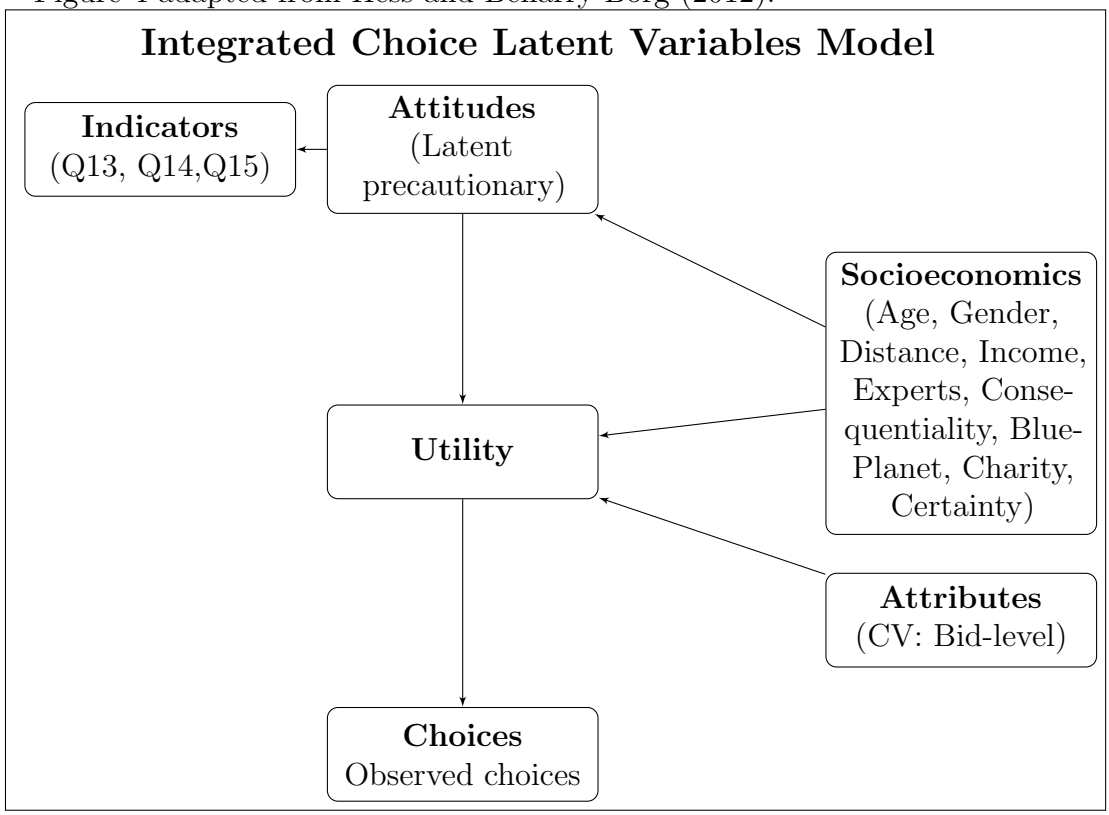
[1] Office of National Statistics:
`https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/employmentandemployeetypes/bulletins/employmentintheuk/march2020`

[2] Mean gross monthly income when removing 'prefer not to say' responses and before using random imputation. The missing values are imputed using a random sampler from the HMISC R package. This is a robust and pragmatic approach to maintaining sample size with missing values.

[3] Office of National Statistics:
`https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/earningsandworkinghours/bulletins/annualsurveyofhoursandearnings/2019`

4. Econometric Methods

This research analyses the CV data using both probit and the ICLV. The ICLV model has three components; a choice model similar to non-hybrid models, measurement equations linking observed likert scale indicators to unobserved latent attitudes, and finally structural equations using socioeconomic variables to understand determinants of the latent attitudes (Vij and Walker, 2016; Czajkowski et al., 2017; Hess and Beharry-Borg, 2012; Ben-Akiva et al., 2002). The interaction of each component is illustrated in Figure 4 adapted from Hess and Beharry-Borg (2012).



The CV responses are evaluated through the lens of Random Utility Theory (RUT) (McFadden et al., 1973). RUT assumes that respondents are rational and will choose options that are utility maximising. Individual utility is composed of deterministic and stochastic components. Utility for alternative a, respondent n in choice task t is composed of a deterministic component, $V_{a,n,t}$ and a stochastic element $\varepsilon_{a,n,t}$ distributed i.i.d extreme value in Equation (4.1) (Train, 2009; Hess and Beharry-Borg, 2012). A uni-

variate probit model is used in this research for the deterministic components. For simplicity, the indirect utility function is reported in Equation (4.2) without functional form with the precise specifications reported in Section 5. The β parameter reports the effect of the bid level on utility. In hybrid choice models, socioeconomic variables effect utility through their effect on latent variables in the Structural Equation (4.3).

Utility:

$$U_{n,j} = V_{n,j} + \varepsilon_{n,j} \tag{4.1}$$

Indirect Utility:

$$V_{n,j} = f\left(\beta, x_{n,j}, \tau, \alpha_n\right) \tag{4.2}$$

The structural equation (4.3) indicates that respondent's n latent attitude α_n is a function of socioeconomic characteristics z and normally-distributed error term η with mean zero and standard deviation σ_α. The effect of socioeconomic characteristics on latent attitudes is estimated by the parameter γ. Ben-Akiva et al. (2002) noted that there is thus one structural equation per latent variable.

Structural Equation:

$$\alpha_n = \gamma Z_n + \eta_n \tag{4.3}$$

As the latent variable is not directly observed, a Measurement Equation 4.4 is used to link unobserved latent variables to observed responses to attitudinal questions. The measurement equation contains δ_{I_k} as an indicator-specific constant, ζ as the estimated effect of the latent variable on the indicator and v as a normally distributed error.

Measurement Equation:

$$I_{nk} = \tau_{I_k} + \zeta_{I_k} \cdot \alpha_n + v_{kn} \tag{4.4}$$

The three ICLV components are combined in the log-likelihood for a full-information, rather than sequential, estimation in Equation 4 (Vij and Walker, 2016). The likelihood of respondent responses to the attitudinal questions is adapted from the Measurement Equation (4.4). The choice parameters to be estimated are the β for the bid level in the CV. From the structural and measurement equations are the λ which represents the effect of the latent variable on utility, the γ for the effect of socioeconomic variables on latent attitudes, the ζ for the effect of specific indicators on attitudes, and finally τ parameters of interaction between the latent variable and the β.

Log-Likelihood function:

$$LL\left(\beta,\gamma,\eta_I,\tau,\sigma_I\right)=\sum_{n=1}^{N} ln\int_{\eta} L\left(y_n|\beta,\tau,\alpha_n\right)L\left(I_n|\eta_I,\sigma_I,\alpha_n\right)g\left(\eta\right)d\eta \quad (4.5)$$

5. Results

The methodological approach in this research is to estimate both univariate probit and ICLV models for both CV questions and then compare the WTP, fit and prediction accuracy. The ICLV choice model is univarite probit which is commonly-used for contingent valuation data (Abate et al., 2020; Zambrano-Monserrate and Ruano, 2020). However, future work to extend the ICLV to include a bivariate or multivariate probit would enable it to be used with double-bound and multiple-bound dichotomous choice CV data. This research compares the WTP and goodness-of-fit between univariate probit and ICLV models for two CV questions.

5.1. Probit Results

Similarly to Abate et al. (2020) and Vij and Walker (2016), this section first reports standard choice models to facilitate comparison against the hybrid choice model. The standard model for dichotomous choice contingent valuation data is univariate probit. The specification can include just the bid levels, as in Abate et al. (2020), or can control for socioeconomic variables. Both models, bid-only and with covariates, are estimated for the two CV questions with results presented in Tables 4. A general result is that WTP for Q7 is larger in absolute magnitude than that for Q6; this suggests that the benefits of immediate restrictions are greater than delaying a decision to resolve uncertainty. This paper shows that this result of a premium in benefits for precautionary restrictions is robust to econometric model.

Table 3: **Bid-only probit models (N = 304).**

Variable	**Estimate**	**Marginal Effect**	**Std. Error**	**Pr(>|z|)**
Question Six				
(Intercept)	0.895***		0.081	0.000
Bid	-0.018***	-0.004	0.001	0.000
Question Seven				
(Intercept)	1.403***		0.055	0.000
Bid	-0.015***	-0.01	0.001	0.000

Table 4: **CVM WTP by model, question, consequentiality and order.**

Specifications	**WTP**	**N**	**AIC**	R^2	**Log-likelihood**	**Accuracy**
Q6 Bid-Only Full-sample	£53.25	670	7103	0.04	-3549.52	50.30%
Q6 Bid-Only truncated-sample	£53.25	304	2968	0.06	-1482.45	46.67%
Q6 covariates Full-sample	£53.23	670	6156.99	0.18	-3061.49	71.94%
Q6 covariates truncated-sample	£50.54	304	2325	0.272	-1150	73.68%
Q6 Consequential Sample	£61.83	560	5128.65	0.176	-2548.32	71.96%
Q6 Inconsequential Sample	£21.32	110	911.572	0.243	-439.78	70.91%
Q6 Order1 Sample	£51.76	364	2651.87	0.227	-1309.94	50.49%
Q6 Order2 Sample	£51.58	306	3289.31	0.192	-1628.65	50.07%
Q6 ICLV Full Sample	74.93	670	5795.22	NA	-2868.25	53.13%
Q6 ICLV Truncated Sample	64.71	304	2935.31	NA	-1170.603	56.23%
Q7 SB Bid-Only Full-sample	£88.43	670	6637.86	0.05	-3316.90	64.48%
Q7 SB Bid-Only truncated-sample	£86.13	304	2623	0.09	-1309.87	68.77%
Q7 SB covariates Full-sample	£91.39	670	6003.08	0.14	-2984.54	71.34%
Q7 SB covariates truncated-sample	£89.79	304	2361	0.171	-1163.77	76.49%
Q7 Consequential Sample	£96.02	560	4808	0.150	-2392.14	73.04%
Q7 Inconsequential Sample	£45.99	110	1131.42	0.0922	-553.71	66.36%
Q7 Order1 Sample	£94.00	364	2681.47	0.151	-1327.74	70.26%
Q7 Order2 Sample	£87.09	306	3189.48	0.176	-1581.74	73.90%
Q7 ICLV Full Sample	92.00	670	5780.50	NA	2863.35	51.19%
Q7 ICLV Truncated	121.26	304	2395.31	NA	1170.60	53.51%

5.2. ICLV Results

The precise specification used for the Q6 ICLV in Table 5 is reported here. The only changes for the Q7 ICLV in Table 6 are changing the outcome vector, the bid levels and the certainty variable as they are task specific. The ICLV and probit models are compared in Table 4. Finally, for comparison with Abate et al. (2020), Figure 1 reports the WTP across different percentiles of the latent precautionary attitude.

Probit Model:

$$V_B = \beta_{Bid} * Q6Bid + \lambda * LatentVariable \tag{5.1}$$

Structural Equation with socioeconomic determinants:

$$\begin{aligned}\alpha_n = \gamma_{Age} * Age + \gamma_{Gender} * Gender \\ \gamma_{Distance} * Distance + \gamma_{Income} * Income + \\ \gamma_{Experts} * Experts + \gamma_{Consequentiality} * Consequentiality + \\ \gamma_{BP} * BP + \gamma_{Charity} * Charity + \\ \gamma_{Certainty} * Q6ResearchCertainty + \eta\end{aligned} \tag{5.2}$$

Ordered Probit Measurement Equation:

$$P_{Y_{n,t=s}} = \Phi(\tau_s - V_{n,t}) - \Phi(\tau_{s-1} - V_{n,t}) \tag{5.3}$$

Table 5: **ICLV CV Model Q6 (N = 304).**

Coefficient	**Estimate**	**Bootstrap.std.err.**	**Bootstrap.p-val(0)**
$\beta_{intercept}$	-67.439***	6.692	0.000
β_{Q6BID}	-32.326***	8.302	0.000
λ	23.704***	1.982	0.000
γ_{Age}	-0.001	0.005	0.409
γ_{Gender}	-0.122	0.174	0.242
$\gamma_{Distance}$	-0.002	0.004	0.328
γ_{Income}	0.220	0.189	0.122
$\gamma_{Experts}$	0.670***	0.140	0.000
$\gamma_{Consequentiality}$	0.279***	0.098	0.002
γ_{BP}	0.443**	0.189	0.010
$\gamma_{Charity}$	-0.005	0.192	0.489
$\gamma_{Q6ResearchCertainty}$	0.470*	0.343	0.086
ζ_{Q13}	0.591***	0.083	0.000
ζ_{Q14}	0.620***	0.090	0.000
ζ_{Q15}	0.624***	0.084	0.000
τ_{Q13_1}	-0.361	0.368	0.164
τ_{Q13_2}	0.673**	0.355	0.029
τ_{Q13_3}	2.262***	0.398	0.000
τ_{Q13_4}	3.349***	0.431	0.000
τ_{Q14_1}	-0.740**	0.421	0.040
τ_{Q14_2}	0.316	0.372	0.198
τ_{Q14_3}	1.803***	0.408	0.000
τ_{Q14_4}	3.058***	0.455	0.000
τ_{Q15_1}	-1.290***	0.498	0.005
τ_{Q15_2}	0.062	0.355	0.431
τ_{Q15_3}	1.441***	0.362	0.000
τ_{Q15_4}	2.585***	0.384	0.000
Estimation Statistics			
Estimation method	bfgs	Iterations	98
Convergence	Successful	LL(start)	-1986.967
Number of individuals	304	LL(final, whole model)	-1224.107
Number of observations	1216	LL(final,indic_Q13)	-373.7579
Number of inter-person draws	1000 (Halton)	LL(final,indic_Q14)	-362.5498
AIC	2502.21	LL(final,indic_Q15)	-341.6773
BIC	2640	LL(final,choice)	-166.6572
WTP			
Measure	**Mean**	**Lower**	**Upper**
Median	£64.71	£49.99	£79.45

$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$

A unique result of this research is that we are able to recover WTP from the CV ICLV. The method used to elicit WTP from the ICLV is similar to the CE in that draws from the unconditional distribution of the latent variable are used. Specifically, the WTP is the median of the estimated intercept divided by the estimated bid coefficient plus respondent specific mean of the distribution. This method is adopted from Buckell, Hensher and Hess (2021), but the significantly larger WTP suggests that further research to verify this procedure would be valuable. The WTP from the ICLV is larger than that from the probit. Comparing the probit bid-only model of £53.25 (£49.86 - £57.25), the ICLV WTP for Q6 is £64.71 (£49.99 - £79.45). This represents an increase of 21% (0% - 38%). The inclusion of covariates and the latent precautionary attitude also increases median WTP more than including covariates in the probit model; compared to the covariates model WTP of £50.54 (£46.04 - £55.03) the ICLV WTP is 27% (8% - 44%) larger. Therefore, the effect of the ICLV approach is to substantially increase WTP. However, according to AIC, the ICLV (2395) fits much better than the bid-only (2968) but marginally worse than the covariates probit (2325) models.

The large magnitude of the bid level suggests that respondents were highly sensitive to the bid level and this, combined with the negative sign, is consistent with a priori theoretical expectations. The standard errors of both the intercept and bid level are also large, which indicates heterogeneity in the magnitude of the parameters across respondents. Linking the choice model and the latent attitudes is the lambda parameter which is large, positive and highly significant. The interpretation is that precautionary attitudes positively influenced the probability of respondents being willing to pay for the hypothetical scenario. Essentially, more environmentally concerned respondents were more willing to pay for research into microplastics.

The γ parameters represent the effect of socioeconomic variables on the latent attitudes. Contrary to the Q6 model, age is now highly significant with a negative effect on latent attitudes suggesting that older respondents are less environmentally concerned. Additionally, distance is now significant, which suggests a distance-decay effect in which distance from the coast reduces environmental concern. However, as these two parameters are not significant in the Q6 probit, their effect on choices is weak and driven only through small changes in latent attitudes. Alternatively, the charity involvement

and belief in experts parameters positively influenced latent environmental attitudes and respondents' choices. The significance of these two parameters is also consistent with the CE models.

The ζ parameters represent the effect of the latent environmental attitudes on the indicator questions while the τ parameters represent the effect of each level of the indicator questions on latent attitudes. The ζ are all highly significant and positive with Q14 again representing the strongest influence on latent attitudes. This is consistent with the CE, although the values are slightly smaller for the CV data. Finally, the τ parameters are almost all statistically significant, the exception being the lowest levels of the indicators. The standard errors for the γ, ζ and τ are all small indicating that the tests are unbiased and there is little heterogeneity in the sample around these values. To summarise, the Q6 ICLV extends the probit model by showing that socioeconomic variables affect WTP through influencing precautionary attitudes. The effect of including latent environmental concern is to show that more environmentally concerned respondents were more willing to pay for the research scenario.

Table 6: **ICLV CV Q7 Model (N = 304).**

Coefficient	**Estimate**	**Bootstrap.std.err.**	**Bootstrap.p-val(0)**
$\beta_{intercept}$	-33.033***	28.222	0.003
β_{Q7BID}	-42.867***	12.709	0.000
λ	28.685***	2.863	0.000
γ_{Age}	-0.005	0.017	0.260
γ_{Gender}	-0.070	0.337	0.335
$\gamma_{Distance}$	-0.004	0.007	0.135
γ_{Income}	0.149	0.148	0.121
$\gamma_{Experts}$	0.517***	0.202	0.000
$\gamma_{Consequentiality}$	0.058	0.157	0.297
γ_{BP}	0.438**	0.404	0.014
$\gamma_{Charity}$	-0.036	0.602	0.440
$\gamma_{Q7TreatmentCertainty}$	0.425***	0.236	0.001
ζ_{Q13}	0.677***	0.124	0.000
ζ_{Q14}	0.767***	0.129	0.000
ζ_{Q15}	0.739***	0.110	0.000
τ_{Q13_1}	-0.859**	0.799	0.012
τ_{Q13_2}	0.214	0.810	0.280
τ_{Q13_3}	1.812***	0.838	0.000
τ_{Q13_4}	2.912***	0.874	0.000
τ_{Q14_1}	-1.285***	0.881	0.002
τ_{Q14_2}	-0.102	0.877	0.400
τ_{Q14_3}	1.455***	0.907	0.000
τ_{Q14_4}	2.761***	0.932	0.000
τ_{Q15_1}	-1.838***	0.813	0.001
τ_{Q15_2}	-0.408	0.807	0.147
τ_{Q15_3}	1.002***	0.823	0.005
τ_{Q15_4}	2.177***	0.844	0.000
Estimation Statistics			
Estimation method	bfgs	Iterations	112
Convergence	Successful	LL(start)	-1834.244
Number of individuals	304	LL(final, whole model)	-1225.148
Number of observations	1216	LL(final,indic_Q13)	-375.8026
Number of inter-person draws	1000 (Halton)	LL(final,indic_Q14)	-363.0384
AIC	2504.3	LL(final,indic_Q15)	-343.701
BIC	2642.09	LL(final,choice)	-170.0473
WTP			
Measure	**Mean**	**Lower**	**Upper**
Median	£121.62	£107.01	£135.52

$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$

There are three noteworthy results from the choice component of the ICLV, the WTP, goodness-of-fit and the coefficients. The ICLV WTP for Q7 is £121.62 (£107.01 - £132.52). Compared to the probit bid-only model of £86.13 (£81.24 - £91.79) and the covariates model of £89.89 (£84.64 - £96.17) represents an increase of 41% (31% - 44%) and 35% (26% - 37%) respectively. Therefore, the effect of the ICLV approach is to substantially increase WTP as in the Q6 and CE models. With regards to goodness-of-fit, the direct comparison of univariate probit to ICLV, however, suggests that adding latent variables does not improve model fit. Finally, similarly to the Q6 ICLV, the bid level is again orders of magnitude different from the probit models, although all are highly statistically significant as expected. The standard errors of the intercept and bid parameter are again large indicating variance in the parameter values. To summarise, the Q7 ICLV fits slightly worse than the univariate probit and reports much larger WTP.

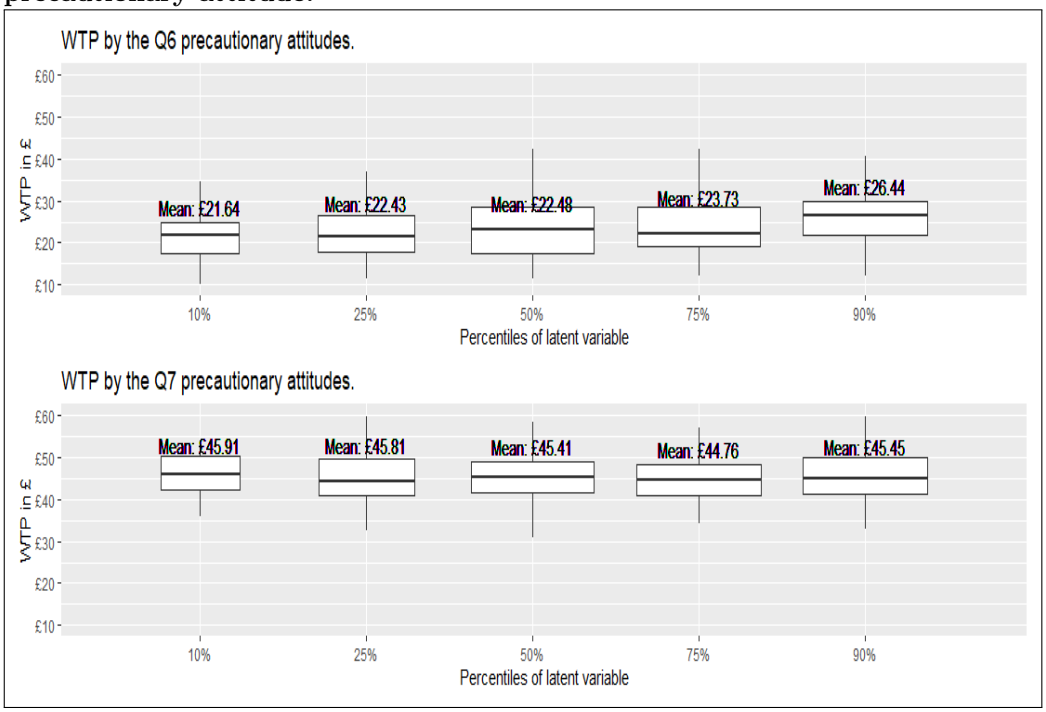
The lambda parameter, which links the latent attitudes to the probit model is highly significant and positive which indicates that respondents who were more concerned about microplastics were more likely to vote yes to the investment scenario. The inference from the γ parameters on the socioeconomic variables is similar to that of the Q6 ICLV. Age and distance are statistically significant and negative suggesting that they influence both attitudes and choices. Moreover, belief in experts and charity involvement are both positive and significant which indicates that they positively influence attitudes and thus choices. The magnitude and significance are also consistent with the Q6 ICLV indicating that there is no difference in the effect between scenarios. Finally, the albeit weak statistical significance of the consequentiality parameter merits further consideration. The positive sign and stronger significance of the parameter is consistent across all Q7 models while it is weakly significant and negative in the Q6 models. This indicates that respondents believed the Q7 scenario to be more consequential, which positively influences attitudes, choices and thus WTP. This difference in consequentiality between the two CV scenarios supports the existence of a premium in terms of additional WTP for precautionary restrictions on the release of microplastics.

The ζ parameters are consistent in sign, significance and magnitude with the Q6 ICLV with Q14 the strongest influence and Q13 the weakest. The inference from the τ parameters is again consistent with the Q6 ICLV,

although the Q7 model has more statistically significant parameters. The uniform result is that higher scores on the Likert scales suggest stronger precautionary attitudes which, then acting with the socioeconomic variables, influence the choice probabilities. The standard errors are again small, suggesting unbiased statistical significance tests which imparts confidence in the comparisons of the Q7 ICLV with the Q6 ICLV and the Q7 univariate and bivariate probit. Overall, the Q7 ICLV suggests that respondents precautionary attitudes positively and strongly influenced their willingness to pay for precautionary restrictizons on the release of microplastics.

Figure 1 reports the CV WTP by quantiles of the precautionary precautionary concern about microplastics. This histogram is similar to Abate et al. (2020). However, a unique result of this paper is that WTP for research is more sensitive to environmental concern while WTP for treatment is relatively stable.

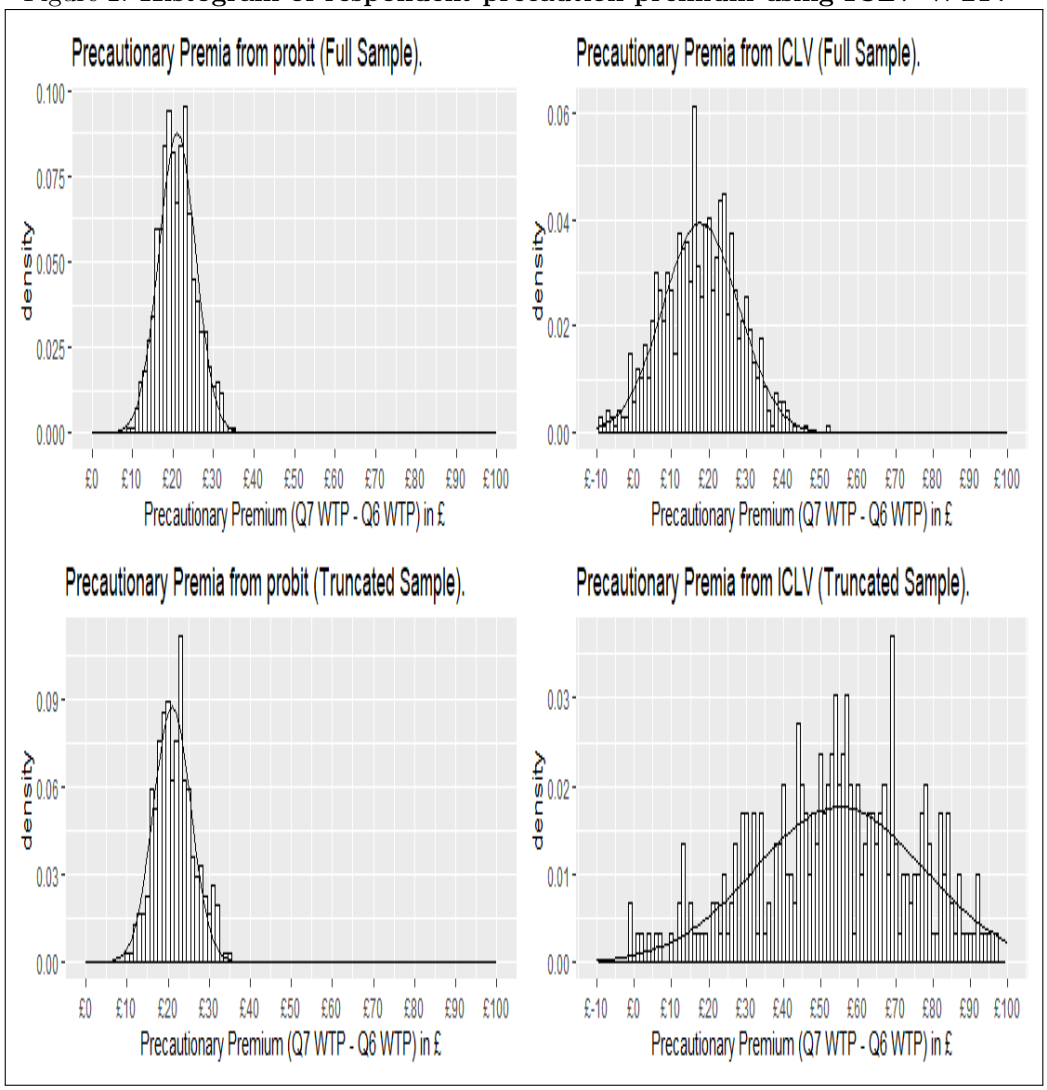
Figure 1: **Box and whiskers plot of CV ICLV WTP by percentiles of the latent precautionary attitude.**



5.3. Precautionary WTP

The difference in respondent WTP between the two scenarios (Q7 minus Q6 WTP) may be interpreted as the increase in benefits from an act-then-learn approach rather than the reverse; hence a premium for precautionary restrictions. The difference in WTP between the two scenarios, research without reductions versus reductions without research, can be interpreted as the increase in benefits for reductions in the release of microplastics compared to researching them. The concept of a precautionary premium arose as an economic interpretation of the precautionary principle although has not been empirically estimated in CV questions (Kuntz-Duriseti, 2004). The value of the premium in this research is reported in Figure 2 the full and truncated samples in both the probit and ICLV specifications. The effect of the ICLV is to allow for greater heterogeneity in valuations while the probit values are more homogeneous. Furthermore, the truncated sample also reports greater variance in the valuations. Compared to £20.99 (CI: £20.14 - £21.49) from the probit, the ICLV reports a precautionary premium of £55.03 (CI: £53.65 - £57.66). The existence and magnitude of the difference was robust to ordering, socioeconomic variables and specification. The difference may be interpreted as the additional increase in benefits to precautionary restrictions. Therefore, the use of two CV scenarios results in support for immediate abatement policies. More generally, this research suggests that respondents prefer to resolve irreversibility over resolving uncertainty.

Figure 2: **Histogram of respondent precaution premium using ICLV WTP.**



6. Discussion

This research has used the ICLV model to indicate that precautionary attitudes increase respondent WTP for restrictions on microplastics. Similarly to Abate et al. (2020), this research evaluates the effect of attitudes about marine plastic on WTP, although it differs in the number and type of latent variables. Additionally, this research is similar to Vij and Walker (2016) in comparing the ICLV to standard choice models, although this research extends the comparison to WTP. The finding that higher levels of the latent attitude correlate with higher WTP is consistent with the hybrid choice literature (Buckell, Hensher and Hess, 2021; Abate et al., 2020; Faccioli et al., 2020). However, the parameters in Table 7 suggest some noteworthy differences from prior implementations of the ICLV.

One immediate observation is that income is never statistically significant from zero in any task. This finding is similar to Hess and Beharry-Borg (2012) who also find no statistically significant income effect when included in their ICLV. Even if income is included by adjusting the bid parameter, as in Buckell, Hensher and Hess (2021), no income effects are revealed in this research. The income dummy approach was inspired by Faccioli et al. (2020) where the dummy equals zero if respondent self-reported income was below the median, and one otherwise. However, they reported that it only has a statistically significant effect on one of their two latent variables. Alternatively, income could be entered as levels, in logs, or as a dummy on whether respondents were willing to report their income (Abate et al., 2020; Adamowicz et al., 2011). However, robustness tests indicate that the small magnitude of the income coefficient was robust to specification. Despite this lack of significance, income should not be dropped to avoid omitted variable bias. While the small effect of including income suggests that income has a minimal effect on precaution, concluding that income does not statistically influence respondents choices directly would be incorrect as income is used in the structural equation, not the choice component.

Some other possible inference is available by comparing the Table 7 with Abate et al. (2020) results. Notably, the sign and statistical significance of the bid, gender, age and charity variables are consistent with their estimation, although comparison of WTP is not feasible. The negative coefficient for gender suggests that male respondents are less concerned with environmental quality, a finding consistent with Abate et al. (2020); Faccioli

et al. (2020) in the ICLV literature, and Cameron (2005); Ortega, Wang and Olynk Widmar (2015) in the more general environmental economics literature. While Fransson and Garling (1999) notes that gender effects are more ambiguous in the environmental psychology literature, the general finding of males being less concerned is consistent with Kollmuss and Agyeman (2002) review. Additionally, charity involvement's positive and highly significant effect suggests that those respondents already have strong precautionary attitudes towards the environment (Zambrano-Monserrate and Ruano, 2020; Abate et al., 2020). Charity involvement suggests that respondents have already undertaken pro-environmental behaviour. Behaviour is a stronger indicator of attitudes than only awareness of an issue (Trivedi, Patel and Savalia, 2015). Therefore, it is no surprise that the coefficient for the viewership of the Blue-Planet media has a weaker but still positive and significant effect on precaution than charity involvement. The effect of media consumption on WTP has been previously by Ortega, Wang and Olynk Widmar (2015), albeit in a different scenario. Finally, the lambda variable representing the latent variable's effect is an order of magnitude larger than Abate et al. (2020). This is possible as the choice model in this research is a bid-only specification, and so the lambda captures other influences on choices, compared to Abate et al. (2020) who included socioeconomic variables in the choice component.

Table 7: **Comparison of ICLV variables across CV questions.**

Coefficient	**Q6**	**Q7**
$\beta_{intercept}$	-67.439***	-33.033***
β_{BID}	-32.326***	-42.867***
λ	23.704***	28.685***
γ_{Age}	-0.001	-0.005
γ_{Gender}	-0.122	-0.070
$\gamma_{Distance}$	-0.002	-0.004
γ_{Income}	0.220	0.149
$\gamma_{Experts}$	0.670***	0.517***
$\gamma_{Consequentiality}$	0.279***	0.058
γ_{BP}	0.443**	0.438**
$\gamma_{Charity}$	-0.005	-0.036
$\gamma_{Certainty}$	0.470*	0.425***
ζ_{Q13}	0.591***	0.677***
ζ_{Q14}	0.620***	0.767***
ζ_{Q15}	0.624***	0.739***
τ_{Q13_1}	-0.361	-0.859**
τ_{Q13_2}	0.673**	0.214
τ_{Q13_3}	2.262***	1.812***
τ_{Q13_4}	3.349***	2.912***
τ_{Q14_1}	-0.740**	-1.285***
τ_{Q14_2}	0.316	-0.102
τ_{Q14_3}	1.803***	1.455***
τ_{Q14_4}	3.058***	2.761***
τ_{Q15_1}	-1.290***	-1.838***
τ_{Q15_2}	0.062	-0.408
τ_{Q15_3}	1.441***	1.002***
τ_{Q15_4}	2.585***	2.177***

$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$

6.1. Implications

In general, future research to estimate the option value or quasi-option value for precautionary restrictions would be valuable in informing the uncertainty-irreversibility tradeoff. More specific suggestions for future work in this area could evaluate the benefits of restrictions on intentionally-added microplastics in other sectors representing a large share of total released microplastics; examples include tyres, detergents, paints and agriculture (ECHA, 2019). Finally, a methodological recommendation would be to estimate the ICLV where the choice model is the Bivariate or Multivariate Probit, enabling researchers to use the ICLV to understand multiple-bound dichotomous choice CV data. Although these questions formats have challenges in the literature, primarily on incentive compatibility, they may elicit a more precise WTP value (Scasny and Zvěřinová, 2014; Choi and Lee, 2018). Therefore, deriving an ICLV with flexible choice models would enable greater insight into CV data.

6.2. Limitations

There are three notable limitations to this work; data collection during the pandemic, small subsample sizes, and not recovering QOV. Firstly, the data was collected as part of a time-sensitive project, which could not be delayed as there was no certainty when a time without the effects of a pandemic would arise. A question was added to the survey to evaluate the timing's impact and indicates a small negative income effect on WTP, suggesting that the benefits to precautionary restrictions may have been higher beforehand. Secondly, the small subsample sizes, exacerbated by the sample's truncation, mean that the order of the sections could not be randomised. Finally, the CV design did not facilitate the estimation of QOV as the two scenarios differ along two different dimensions; a reduction and learning. Future work could vary the scenarios along only one of these and potentially isolate the QOV to precautionary restrictions.

6.3. Summary

This research elicited WTP for different policy options from a representative sample of 670 UK adults. The two CV questions were analysed using the ICLV and indicated that environmental attitudes and concerns about the potential adverse health and environmental impacts of microplastics were a powerful motivator of precautionary WTP. Comparing WTP between the two CV questions indicates that respondents support precautionary restrictions on microplastics' irreversible release despite the scientific uncertainty.

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8. Appendix

Table 8: **Q6 ICLV with income adjustment (N = 304).**

Coefficient	**Estimate**	**Bootstrap.std.err.**	**Bootstrap.t.ratio(0)**	**Bootstrap.p-val(0)**
$\beta_{intercept}$	13.610	18.663	0.729	0.203
β_{Q6BID}	-32.384	9.731	-3.328	0.000
$Income_{Elasticity}$	-0.066	0.123	-0.540	0.219
λ	29.398	1.743	16.867	0.000
γ_{Age}	-0.021	0.006	-3.587	0.000
γ_{Gender}	-0.006	0.145	-0.039	0.484
$\gamma_{Distance}$	-0.010	0.004	-2.713	0.003
γ_{Income}	0.000	0.000	0.307	0.365
$\gamma_{Experts}$	0.293	0.106	2.769	0.001
$\gamma_{Consequentiality}$	0.013	0.195	0.067	0.469
γ_{BP}	0.324	0.104	3.120	0.000
$\gamma_{Charity}$	0.351	0.109	3.207	0.002
$\gamma_{Q12CECertainty}$	-0.053	0.108	-0.489	0.311
ζ_{Q13}	0.655	0.098	6.667	0.000
ζ_{Q14}	0.712	0.108	6.599	0.000
ζ_{Q15}	0.701	0.095	7.389	0.000
τ_{Q13_1}	-2.376	0.432	-5.498	0.000
τ_{Q13_2}	-1.291	0.381	-3.391	0.000
τ_{Q13_3}	0.245	0.396	0.618	0.249
τ_{Q13_4}	1.312	0.421	3.116	0.000
τ_{Q14_1}	-2.793	0.496	-5.631	0.000
τ_{Q14_2}	-1.773	0.423	-4.189	0.000
τ_{Q14_3}	-0.263	0.422	-0.623	0.249
τ_{Q14_4}	0.978	0.440	2.219	0.007
τ_{Q15_1}	-3.319	0.547	-6.063	0.000
τ_{Q15_2}	-2.150	0.443	-4.853	0.000
τ_{Q15_3}	-0.669	0.414	-1.614	0.041
τ_{Q15_4}	0.497	0.422	1.179	0.099

Estimation Statistics			
Estimation method	bfgs	Iterations	63
Convergence	Successful	LL(start)	-1859.134
Number of individuals	304	LL(final, whole model)	-1172.09
Number of observations	1216	LL(final,indic_Q13)	-365.008
Number of inter-person draws	1000 (Halton)	LL(final,indic_Q14)	-349.6076
AIC	2400.18	LL(final,indic_Q15)	-327.8978
BIC	2541.27	LL(final,choice)	-170.1658

WTP		
Measure	**Mean**	**Lower**	**Upper**
Median	£63.68	£49.64	£79.08

$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$

Table 9: **Q7 ICLV with income adjustment (N = 304).**

Coefficient	**Estimate**	**Bootstrap.std.err.**	**Bootstrap.t.ratio(0)**	**Bootstrap.p-val(0)**
$\beta_{intercept}$	-37.038***	35.072	-1.056	0.011
β_{Q6BID}	-42.165***	9.512	-4.433	0.000
$Income_{Elasticity}$	-0.110*	0.143	-0.764	0.085
λ	30.437***	4.802	6.339	0.000
γ_{Age}	-0.004	0.016	-0.280	0.288
γ_{Gender}	-0.067	0.181	-0.369	0.330
$\gamma_{Distance}$	-0.003	0.008	-0.401	0.236
γ_{Income}	0.000	0.000	0.270	0.351
$\gamma_{Experts}$	0.513***	0.109	4.696	0.000
$\gamma_{Consequentiality}$	0.315***	0.123	2.567	0.008
γ_{BP}	0.035	0.129	0.271	0.369
$\gamma_{Charity}$	0.470***	0.360	1.307	0.006
$\gamma_{Q12CECertainty}$	0.117	0.310	0.376	0.237
ζ_{Q13}	0.662***	0.098	6.768	0.000
ζ_{Q14}	0.755***	0.107	7.052	0.000
ζ_{Q15}	0.766***	0.101	7.560	0.000
τ_{Q13_1}	-0.866**	0.943	-0.918	0.031
τ_{Q13_2}	0.244	0.936	0.261	0.293
τ_{Q13_3}	1.786***	0.964	1.852	0.000
τ_{Q13_4}	2.859***	0.986	2.901	0.000
τ_{Q14_1}	-1.175***	1.062	-1.107	0.014
τ_{Q14_2}	-0.066	1.040	-0.063	0.447
τ_{Q14_3}	1.492***	1.064	1.402	0.002
τ_{Q14_4}	2.762***	1.074	2.571	0.000
τ_{Q15_1}	-1.716***	1.018	-1.685	0.004
τ_{Q15_2}	-0.449	1.031	-0.435	0.187
τ_{Q15_3}	1.089**	1.025	1.062	0.016
τ_{Q15_4}	2.303***	1.032	2.231	0.000

Estimation Statistics			
Estimation method	bfgs	Iterations	118
Convergence	Successful	LL(start)	-1715.644
Number of individuals	304	LL(final, whole model)	-1150.265
Number of observations	1216	LL(final,indic_Q13)	-355.2907
Number of inter-person draws	1000 (Halton)	LL(final,indic_Q14)	-341.1318
AIC	2356.53	LL(final,indic_Q15)	-319.9077
BIC	2497.62	LL(final,choice)	-158.5154

WTP			
Measure	**Mean**	**Lower**	**Upper**
Median	£164.82	£148.32	£178.41

$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$